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ORIGINS OF AGRICULTURE IN MESOAMERICA

by

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INTRODUCTION

The story of agriculture in Mesoamerica begins with an era of "incipient cultivation". By this term it is meant that domesticated food plants played only a minor role in the subsistence of societies dependent for the most part upon the collecting of wild plants and the hunting of small game. Gradually, the cultivated plants assumed greater economic importance. More plants were brought under domestication, and others were improved over the centuries by selection. Eventually, with agriculture becoming the primary and established subsistence mode, the era of incipient cultivation came to an end. This article is a summary of this early history of plant cultivation in Mesoamerica. It will consider, in order, native wild plants of the area, circumstances favorable for the cultivation of these, a review of the archaeological evidence for plant domestication, plant genetics, plant distributions, and the place of Mesoamerican cultivation in the larger setting of the native New World.

Before beginning such a survey let us note, briefly, the position and context of the "era of incipient cultivation" which is to be our main concern (Willey, 1960 a, b). The fully agricultural basis of life for Precolumbian Mesoamerica is known from sixteenth century records and from ethnographic observations of modern times. For the centuries immediately preceding the Spanish Conquest, agriculture is known or inferred from a variety of archaeological evidences. Going back somewhat

further in time, to the Preclassic Period of the first and second millennia B.C., it is generally assumed that the earliest cultures of this period were supported by the cultivation of food crops (Willey, Ekholm, and Millon, this volume). The "era of incipient cultivation" precedes the Preclassic Period. Actually it is an era or period of food-collecting together with "incipient cultivation". The societies of that time were small bands, living under semi-nomadic conditions and gaining a livelihood by collecting wild plants, killing and snaring small game, and to a minor extent, planting and reaping. The chronological span of time involved for such an era is estimated, upon the basis of radiocarbon dates, to have been about 6000 B.C. ± 1000 years to 1500 B.C. ± 500 years (MacNeish, this volume). It is believed that prior to 7,000 B.C. man's food quest in ancient Mesoamerica was oriented more toward the pursuit and killing of large animals, under Pleistocene environmental conditions (Aveleyra, this volume), than toward plants and small game. With the onset of a warmer, drier climate, following the Pleistocene, the small game hunting and plant collecting subsistence came into being; and, at least in certain Mesoamerican regions, plant domestication developed in this context.

I. PLANT CULTIVATION IN MESOAMERICA

A. Circumstances Favorable for Development of Agriculture

There can be little doubt that the agriculture of the New World is an indigenous development. The Asiatic peoples who crossed Bering Strait on the wide land bridge, which almost certainly existed at a time when the sea level was 150 to 180 feet lower than at present (Hopkins, 1959), were undoubtedly strangers to the art of cultivation. Agriculture had not yet been invented in the Old World and in any case it would not have been extensively practiced in northeastern Asia where these migrants to the New World originated or successfully carried across the barren tundras of the strait into a not much more favorable area of what is now Alaska. Even after these peoples reached the region now the United States and southern Canada, which has subsequently proved to be well suited to agricultural enterprises, there were few plants which could have been successfully domesticated. Only one cultivated plant of any importance, the annual sunflower, has originated in the region now the United States and its domestication may have come relatively late, (Heiser, 1955) and may have been inspired by the experience of successful domestication further south.

Not until these nomadic hunting and food-gathering peoples reached the region now Mexico and northern Central America did they encounter a combination of conditions which were conducive to the development of plant domestication and the practice of agriculture.

One of the factors involved in creating centers of domestication, according to Vavilov (1951), is a great diversity in the natural vegetation.

As an example he cites the two small republics of Central America, Costa Rica and Salvador with areas about one hundredth that of the United States, but which possess a number of species as great as is found in all of North America including the United States, Canada, and Alaska. Although taxonomists may question this particular statement it is undoubtedly true that the floras of the countries of Mesoamerica are rich and exhibit a great diversity of species and varieties. This diversity in vegetation is the product, in substantial part, of a corresponding diversity in ~~is in turn related to a great array of ecological conditions and~~ habitats which is provided by a wide range in altitude~~s~~, temperature, and rainfall. and which promotes geographic differentiation of the genera and species inhabiting the area ~~One has only to look at a map of Mesoamerica in which altitudes are shown by hypsometric tints to see at a glance how wide is the range in this variable. It is equally wide in others.~~

In addition to a rich flora, which is more likely to include plants amenable to domestication than a sparse one, there must be other factors and conditions which contribute to the invention and development of agriculture. On this point there are a variety of opinions.

Payne (1892) has suggested that agriculture probably originates first with root-crop culture since the disturbance of the soil in the search for roots has in itself the character of tillage. Also the act of planting a root scarcely differs from that of digging one up; the implement used being the same for both, a simple fire-hardened stake, the universal implement of primitive agriculture. To Payne's arguments it should be added that no complex processing operations are required in preparing the majority of roots for consumption. Many can be eaten raw or cooked by simple means: roasted over hot coals or steamed in shallow pits over heated stones. No implements or utensils are needed for threshing, milling, or baking. The growing and processing of roots is undoubtedly more simple than comparable operations involving the cereals.

Sauer (1959), like Payne, has New World agriculture originating with root culture but for somewhat different reasons. He postulates that hunting and fishing people living a comfortable life began to cultivate the native vegetatively propagated root crops not from necessity but because with leisure on their hands they had time to take steps to improve their lot by providing, among other things, themselves with a source of carbohydrates to supplement an otherwise highly proteinaceous diet. Sauer suggests that agriculture began in northern South America, perhaps in Colombia, with manioc, the native yam, arracacha, Xanthosoma (the American counterpart of the Old World taro), and other root crops. As this type of agriculture spread into the Andes other root or tuberous crops especially adapted to high altitudes, including oca, ulluco, año, and the potato, were added to the complex. The peanut was domesticated because a plant which buries its fruit resembles, superficially at least, the root crops which store their food reserves underground. This root-crop type of agriculture was also extended northward to its limits but was not adopted in Mexico in early times because no suitable root crops were available. Instead the requirements for a balanced diet were met by domesticating plants reproduced by seed, especially maize, beans, and squashes.

Sauer's hypothesis, though in many respects plausible, has little evidence to support it. True, there is some indication from the finding of griddles, presumably used in the preparation of manioc bread, that the cultivation of this plant began at a relatively early date, perhaps as early as 1000 BC (Cruxent and Rouse, 1958), but it is doubtful that it preceded the cultivation of maize, beans, and squashes in Mexico.

Recent archaeological evidence tends to support not Sauer but Spinden who (1917) expressed the opinion that agriculture would be more likely to originate "under conditions that were hard rather than under those which were easy. ~~Under~~ An environment producing a healthy but hungry population, particularly a semi-arid environment, ~~which~~ would offer special inducements to the first agriculturists. Here they would encounter no heavy work in preparing the soil and irrigation would make them the masters of nature."

Even before irrigation had been invented, however, there would have been obvious advantages in a semi-arid climate where weeds, insect pests, and fungus diseases are less of a problem than in tropical lowlands and where living conditions in general are more healthful. Also the plants on which the earliest agriculture of Mexico was based; primitive maize, beans, and squashes, are plants better adapted to intermediate and fairly high altitudes - to a clima medio - than to the tropical lowlands. The beginnings of agriculture should be sought, we think, at intermediate altitudes in tropical regions which have distinct rainy and dry seasons and natural vegetations of great diversity. These conditions are met especially well in parts of Mesoamerica and it is here where the earliest archaeological remains of several important American cultivated plants are found.

B. A REVIEW OF THE ARCHAEOLOGICAL EVIDENCE FOR EARLY PLANT CULTIVATION

The earliest occurrences of cultivated plants in Mesoamerica and the most complete record of their development through time come from archaeological sites in the Mexican states of Tamaulipas and Puebla. The former region lies at the northeastern margin of Mesoamerica; the latter is near the geographical center of the area. There are also evidences of early, probably cultivated, maize in pollen taken from soil borings made in the Valley of Mexico, and from cave deposits in Chiapas in Southern Mexico.

The archaeological sites in Tamaulipas are dry caves in which the plants themselves, and plant particles in human faeces, are found in deeply stratified layers of dusty refuse. The cultural contexts of these plant finds are described elsewhere (MacNeish, this volume). In discussing the plants it will be necessary to refer to phase names, and dates, of two archaeological sequences, one for the Sierra de Tamaulipas and the other for the Sierra Madre Oriental of the southwestern part of the State of Tamaulipas. These sequences are closely related, and they are cross-referenced and dated in the diagram, Figure 1.

The earliest of the Tamaulipas culture phases with plant remains is the Infiernillo. It is dated at 7,000-5,000 B.C., and a number of plants are attributed to it. Some of these are definitely wild, such as the agave, the opuntia, and the runner bean (_Phaseolus coccineus_) (Kaplan and MacNeish, 1960; MacNeish, Ms. 1959). Possibly wild or possibly domesticates are the gourd (_Lagenaria_) and the chili pepper (_Capsicum annuum_ or _C. frutescens_) (Whitaker, Cutler, and MacNeish, 1957; Callen and MacNeish,). The best case for a cultivated plant at this early time is the summer squash or

pumpkin (Cucurbita pepo). The plant, apparently, was first utilized for its seeds. Several of these seeds have been found in an Infiernillo deposit, and some authorities believe domesticates to be represented among them (Whitaker, Cutler, and MacNeish, 1957; MacNeish, Ms. 1959).(1)

Indisputable domesticates, yellow and red large beans (Phaesolus vulgaris), come into the Tamaulipas sequence in the phase succeeding the Infiernillo, the Ocampo, dated at 5,000 to 3,000 B.C. (MacNeish, 1958, pp. 167-68; Ms. 1959; Kaplan and MacNeish, 1960). Also, Ocampo pumpkins are a larger seeded variety than those of the preceding Infiernillo phase, and there is now no doubt that they are cultivated (Whitaker, Cutler, and MacNeish, 1957). A new wild plant, eaten in Ocampo times, is Panicum sonora, a type of millet (Callen and MacNeish.)

The great American Indian domesticated plant, maize (Zea mays), dates first from La Perra phase times, somewhere between 3,000 and 2200 B.C. in the Tamaulipas sequence (MacNeish, 1958, p. 155).(2) It is a primitive corn, represented by two varieties (A and B) of the early Nal-tel race (Mangelsdorf, MacNeish, and Galinat, 1956; Callen and MacNeish,).

After 2200 B.C. the Tamaulipas cave sequences show a rapid build-up of cultigens. The Bat Cave, or Chapalote, race of maize appears in the Flacco phase (2200-1800 B.C.), and in the Mesa de Guaje phase (1400-500 B.C.) both Bat Cave and new hybridized varieties of corn are present along with the maize-tripsacum cross, teosinte. In the Laguna phase (500-0 B.C.) there are three new important races of hybridized corn, Breve de Padilla, Dzit-Bacal, and Nal-tel (Mangelsdorf and Reeves, 1959;

Mangelsdorf, MacNeish, and Galinat, 1956). Shortly after this, in early Palmillas phase times (0 - A.C. 500), black beans, small red beans and the lima bean (*Phaesolus lunatus*) come into the sequence (Kaplan and MacNeish, 1960) and a great increase in the varieties of pumpkins (*Cucurbita pepo*) occurs (Whitaker, Cutler, and MacNeish, 1957). In addition, the warty squash (*Cucurbita moschata*) is known from the Guerra phase (1800-1400 B.C.) and the Walnut squash (*Cucurbita mixta*) from the Palmillas (300-800 A.D.) (Ibid.). *Amaranthus*, a well-known Mexican food plant, is as old as 2200 B.C. although its status as a wild or a cultivated one is uncertain (Callen and MacNeish,). Cotton (*Gossypium*) is first noted in the cave debris in the Guerra phase (1800-1400 B.C.), and the first tobacco (*Nicotiana rustica*) is placed in Palmillas (300-800 A.C.) (MacNeish, Ms. 1959). *Manihoz dulcis*, or sweet manioc, a possible domesticated food plant, is known from the Laguna phase (500 B.C. - 0). This tamaulipas manioc, although closely related to the Manihor esculenta of the South American lowlands, had a separate and local history of cultivation.

To sum up the Tamaulipas cave sequences, and to relate the development of plant domestication in these sequences to other aspects of culture and society, we note the following trends. During the Infiernillo, Ocampo, and La Perra phases, or from about 7,000 to 2200 B.C., domesticated food plants make up no more than 10 to 15 percent of the total diet. The pumpkin and the bean were the earliest domesticates; maize, of a primitive sort, was added later. Communities were small and life probably semi-nomadic with only seasonal return to the cave sites. From 2,200 to 500 B.C., in the Flacco, Almagre, Guerra, and Mesa de Guaje phases,

cultigens increase to as much as 40 percent of total diet by the terminal date. Sites are larger and some of them might be described as the village locations of semi-sedentary populations. New races of maize appear and are hybridized. Still later (500 B.C. - A.D. 500), more food plants are added to the complex, diet becomes essentially agricultural, and stable villages and towns appear (MacNeish, 1958, pp. 199-203, Ms. 1959).

It will be noted that this transition from early incipient to full village agriculture in Tamaulipas is chronologically somewhat behind the dating estimates given in the Introduction to this paper. By 1500 B.C., or even 1000 B.C., the cave dwellers and semi-sedentary villagers of the Tamaulipas mountains had not achieved a fully established agricultural economy. In fact, this does not seem to have been attained here until sometime between 500 B.C. and A.D. 500, well into Preclassic or even Classic Period times if measured against developments farther south in Mesoamerica. The implications of this are that plant cultivation, in both its incipient and fully established stages, are probably earlier near the "heart" of the Mesoamerican area than they are on the Tamaulipas peripheries. What archaeological plant evidence is there to support this hypothesis?

To date, the most significant discoveries pertaining to this problem
Ajuereado
have come from a dry cave at Aeyerado, near Cocotlan, in southern Puebla.
Although only test excavations have been carried out so far, six maize cobs
Were recovered from deep refuse layers. Three of these cobs
are probably domesticates; but the other three from the very deeper levels
quite
are primitive in appearance and it is possible that these latter three
One squash seed appeared underneath the levels with maize
represent the wild ancestor of cultivated maize. In the upper pre-ceramic
levels of Aeyerado Cave, maize cobs are definitely domesticates, and some

show teosinte introgression. Also, beans, pumpkins, gourds, amaranth and chile occur The ~~Aeyerado~~ Ajuereado sequence terminates with the appearance of Preclassic and Classic-Period pottery and well developed maize.(3) Although only a preliminary examination of the earliest Aeyerado artifacts has been made, the chipped stone tool types appear to correlate most closely with those of the upper pre-ceramic levels (5000-3500 B.C.) of the Santa Marta Cave in Chiapas as well as with the Ocampo phase of the Tamaulipas sequence. If this correlation is supported by an early radiocarbon date for the lower Aeyerado levels it would strongly suggest an early Mesoamerican hearth of maize domestication well to the south of Tamaulipas.(4) (The next to earliest corn level has been dated at 3600 B.C. ± 250 (M1087)

The Puebla maize discoveries have some corroboration in studies of fossil pollen made in the Valley of Mexico, a short distance to the north but still well south of Tamaulipas. Here, pollen of what is probably domesticated maize has an early Post-Pleistocene geological estimated date (ca. 5,000 B.C.). In this same connection, it is interesting to note that there is still older maize pollen, presumably wild, from the Valley of Mexico (Barghoorn, Wolfe, and Clisby, 1954).

The most significant generalization which emerges from all of the archaeological facts on plant cultivation in Mesoamerica is that there were regional specializations at a very early time. In Tamaulipas, pumpkins ~~squash~~ and then common beans were cultivated long before maize; in Puebla, squash and maize ~~has~~ had the earlier history. By about 2,000 B.C., however, there had been sufficient diffusion of cultivated plants within the Mesoamerican area to produce a complex of agricultural foods -- essentially maize, beans, squashes, and chili peppers -- that revolutionized the whole nature of plant growing from a level of incipient

cultivation to one of village agriculture. By the time of the advent of the Spanish the Mesoamerican agricultural complex - augmented by new cultigens developed locally and imported from other American areas - was the richest assemblage of food plants in the western hemisphere.

C. The Cultivated Plants of Mesoamerica

The most intensive studies which have been made of the cultivated plants of the world are those of the Russian botanist, Vavilov, and his collaborators. These have involved numerous expeditions on a world-wide scale conducted between the two world wars and the most extensive collections of cultivated plants ever assembled. As a result of these studies Vavilov (1951) recognized eight world centers of origin of cultivated plants, one of which includes southern Mexico, Central America, and the Antilles and is considered to be the center of origin of more than 50 cultivated species.

Vavilov's list is not complete, however, and is undoubtedly in error in assigning the origin of the sweet potato to this center and in omitting one of the most widely-grown squashes, Cucurbita Pepo. More recently Dressler (1953) has made an exhaustive study of the literature, including early historical sources as well as Vavilov's and other Russian works, which are concerned with the cultivated plants of Mexico. Dressler lists 88 different species of which 71 are regarded as being of Mexican-Central American origin and 17 were introduced from elsewhere or are of uncertain origin. Although Dressler's work is concerned principally with Mexico, most of the species which he lists are grown also in Central America.

In Table 1 we have combined the data of these two authors, following the procedure of Vavilov in listing the plants in categories, based upon their use, but employing somewhat different categories, and following Dressler with respect to the Latin names, since he has made a

special effort to determine for each species the correct Latin name which meets the requirements of the rules of botanical nomenclature. To make the table as complete as possible we have added the names of the families to which the species belong and we have indicated with asterisks those species which we consider not to be indigenous to Mesoamerica but to have been introduced from elsewhere. A few species are included in more than one category.

The list of species set forth in Table 1 is impressive, not only in the large number of species which it includes but also, in calling attention to the fact that a number of genera, notably, _Phaseolus_, _Cucurbita_, _Annona_, _Opuntia_, _Theobroma_, _Agave_, and _Dahlia_, are each represented by several species. This provides tangible evidence of the fact, mentioned earlier, that the Mesoamerican floras, because of their richness and diversity, undoubtedly contained many species amenable to domestication and it suggests that the Mesoamerican people, once they had learned the art of domestication practiced it whenever they encountered such species. The list of cultivated plants that the also shows that the domestication of plants in Mesoamerica reached an advanced, indeed in some respects a highly sophisticated, state—a number of species being cultivated as ornamentals and several as host plants for "domestic" insects. However the majority of the species listed in Table 1 are of minor agricultural importance and are of limited usefulness in tracing the beginnings of agriculture in Mesoamerica. Consequently we shall confine further discussion to those species which are of major importance agriculturally and which may be critical in tracing the beginnings of agriculture and its subsequent spread to other parts of the hemisphere. These include maize, beans, squashes, the bottle gourd, cotton, and tobacco. (6)

1. Squashes

Both wild and cultivated squashes are represented in the vegetal remains of the Ocampo caves. Rinds and shells of the wild species, *Cucurbita foetidissima* were found at all levels in the caves (Whitaker, Cutler, and MacNeish, 1957, p. 356). Since the flesh of the fruits of this species is quite unpalatable, as its Latin name may suggest, it is probable that this squash was used for its seeds which are quite nutritious. Carter (1945, p. 30) has suggested that the Cucurbits in general first attracted attention for their seeds which are easily gathered, are palatable, and have a high oil content.

Three cultivated species of squashes: *C. Pepo*, *C. Moschata*, and *C. mixta*, were identified among the archaeological remains of the caves. A fourth species, cultivated in Peru, *C. maxima*, has never been found archaeologically in Mesoamerica and this fact furnishes one of a number of examples of independent domestication in the two regions.

a. *Pumpkin* and Summer Squash, *Cucurbita Pepo*, L. - This species in modern horticulture includes many varieties: the golden fall pumpkin; a diversity of summer squashes including yellow crookneck squashes, acorn squashes, scallop or pattypans, zucchinis, vegetable marrows; and the small inedible gourds grown for ornamental purposes. This species makes its first appearance in Mexico in the Infiernillo Phase, 7000-5000 B.C. However, of these earliest seeds, those illustrated by Whitaker *et al*. in their Figure 4, are very small and may well represent wild squashes. Somewhat larger seeds which may be those of cultivated squashes were also found at this level,(1) as well as in the Mesa de Guaje culture dated at

1400-500 B.C. The absence of C. Pepo in Peru like the absence of C. maxima in Mesoamerica is evidence that the domestication of the squashes was, to some extent at least, independent in the two regions.

b. Cushaw Squash, Cucurbita moschata, Duchesne - This squash, represented in contemporary horticulture in the United States by the cushaw of the southern states and butternut squash of the northern states, definitely makes its appearance in the Ocampo Caves at 1400-500 B.C., and there is one peduncle, probably of this species, dated at 1800-1400 B.C. (Whitaker et al. p. 357). It is impossible to determine from these early specimens - all peduncles - whether they are wild or cultivated. This species is also represented in the early levels of Huaca Prieta site in Peru dated at about 2000 B.C. (Whitaker and Bird, 1949). The fact that C. moschata has its center of diversity in Central America and northern South America indicates that this may be the primary center of domestication. Recent archeological finds of squash at 6000 B.C. in Panama tend to confirm this hypothesis The criterion of diversity is, however, far from infallible and can result in serious errors such as that which Vavilov (1951) made when he placed the origin of C. Pepo in the Near East because the greatest diversity of its varieties occurs in Asia Minor. Centers of diversity may be centers of convergence as well as centers of origin.

Although C. moschata occurs in both Mesoamerica and Peru and although it makes its first appearance in the two regions at about the same date, it is represented by distinct types, a brown-seeded one in South America and a white-seeded one in Mexico. These are sufficiently different to be regarded by some authorities as distinct subspecies (Bukasov, 1930).

It cannot be said, at least with any degree of confidence, that C. moschata was first domesticated in Peru and later introduced into

Mexico or *vice versa*. If any conclusion is to be drawn at this point it would be that domestication of *C. moschata* probably occurred independently in the two regions from somewhat different wild geographic races or subspecies. (MacNeish, however, on the basis of the Puebla data suggests it has a single center of origin south of Puebla and Oaxaca.)

c. Walnut Squash, *C. mixta*, Pang - This species, coming quite late (150-850 A.D.) in the cultural sequence and never reaching South America, has little bearing either on the beginnings of agriculture or its subsequent spread.

2. Beans

Four species of beans: the tepary bean, the runner bean, the lima bean, and the common bean, are known today in Mesoamerica and with the exception of the first all have now been found archaeologically, as noted above, in this region. The relatively early dates at which they occurred suggest that they may be native to the region and there is support for this supposition in the occurrence of wild forms of several of these species.

a. Tepary Bean, *Phaseolus acutifolius*, A. Gray - Wild forms of the tepary bean occur in northern Mexico and in the southern part of the southwestern United States (Carter, 1945) and since this species is unknown in South America either archaeologically or as commonly grown cultigen in modern times, there can be little doubt that it originated either in Mesoamerica or near its northern periphery. It has not yet been found archaeologically in early Mexican sites and may represent a comparatively recent addition to the Mesoamerican agricultural complex.

b. Runner Bean, Phaseolus coccineus, L. - This bean, like the tepary, is clearly not of South American origin since it is unknown there archaeologically and is little used in contemporary agriculture. Wild plants of this species have been collected in Guatemala and in the states of Puebla, Zacatecas, Coahuila, Mexico, Jalisco, and Chiapas in Mexico (Kaplan and MacNeish, 1960). These authors also conclude that the runner beans found archaeologically in the Infiernillo phase of Romero's Cave dated at 7000-5000 B.C., may have been those of wild plants although this species is not known in the wild in Tamaulipas today. They suggest that a second thermal period may have been the cause of the extinction of P. coccineus from this part of its native range.

c. Lima Bean, Phaseolus lunatus, L. - Since the lima bean does not occur archaeologically in Mesoamerica until 0-500 A.D. and has been identified from preceramic levels dated at 2000 B.C. in the Huaca Prieta site in Peru (Towle)(~~6~~7) it might be supposed that this species represents an introduction into Mesoamerica from South America. However, the lima beans in the two areas are quite different, the Peruvian form being a large-seeded type and the Mexican a small-seeded type known to horticulturists as the "sieva" lima. Mackie (1943) has placed the origin of the lima bean in the Guatemala - Chiapas area and wild forms of a small-seeded type have been collected in this region. Recently a lima bean has been collected in Peru growing on the terraces of Ollantaitambo in the Urabamba Valley by Ing. Alexander Grobman of the National School of Agriculture. Because of its hard, thickened shell, which differs from that of any cultivated lima, this bean has been identified as a wild form by Dr. R. W. Allard, University of California. The same form is reported by

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Ing. Alfonso Cerrate to be common in the Department of Ancash in Peru.(7) This wild lima has seeds much larger than those of the wild lima of Guatemala. It seems probable, therefore, that the lima beans of Mesoamerica and of South America represent separate domestications of two distinct wild races or subspecies.

d. Common Bean, Phaseolus vulgaris, L. - The situation with respect to the common or kidney bean is in some respects a counterpart of that involving the lima bean. Wild beans of this species, or one closely related to it, have been found in both Mesoamerica and South America (Kaplan & MacNeish, 1960, p. 53) and this suggests at once the possibility of an independent domestication of beans in the two regions. Furthermore the modern bean varieties of Mexico and South America, although regarded as belonging to the same species, are quite different in many of their horticultural characteristics including various physiological responses to environmental conditions, disease resistance, and productiveness. Nevertheless, the fact that this species appears quite early in Mexico, 5000 - 3000 B.C., and relatively late, 400 B.C., in South America is consistent with the hypothesis of a Mesoamerican origin and a later spread to South America. More data on the genetic and cytological relationships of the cultivated varieties to the various wild forms are needed before final conslusions on this problem can be reached. Recent archaeological bean evidence from Puebla and a survey being done in conjunction with the Tehuacan project proj may do much to clarify the problem.

3. Maize

Of all of the cultivated plants of Mesoamerica, maize was by all odds the most important. There was no well-developed, prehistoric agriculture in any part of this region in which maize was not the principal

crop. Even today there are millions of "indigenas" in Guatemala and Mexico to whom maize is quite literally the staff of life and whose agriculture is based upon the growing of this plant.

Whether maize originated in this region, and only here, are questions to which complete answers have not yet been found. The evidence is conflicting and authorities do not agree. Earlier students of maize were virtually unanimous in postulating a South American origin: St. Hilaire assigning it to Paraguay, DeCandolle to New Granada, and Darwin to Peru (c~~o~~f Mangelsdorf and Reeves, 1939). Later when the close relationship of maize and teosinte was discovered the scene shifted from South America to Mexico. Except for Sturtevant, who still held to a South American origin, opinions were almost unanimous that maize had its beginnings in Mexico and argument was confined, as Collins once stated, "to the rival claims of particular Mexican localities." Harshberger, Collins, Kempton, Kempton and Popenoe, Vavilov, Kuleshov, Weatherwax, and later Randolph, all postulated a Mexican or Central American-Mexican origin primarily because teosinte, the closest relative of maize, is confined to this general region and is unknown in South America except where it is rarely cultivated (Mangelsdorf and Reeves, 1939).

Mangelsdorf and Reeves (1939), on the basis of their cytogenetic studies of maize and its relatives, concluded that teosinte is a hybrid of maize and Tripsacum rather than the progenitor of maize and postulated that maize as a wild plant originated in the lowlands of South America and that the Andean region became the primary center of diversification. Later, however, when fossil maize pollen was discovered in the Valley of Mexico (Barghoorn _et_ _al_., 1954), Mangelsdorf (1954) concluded that "maize

undoubtedly had at least one center of origin in Middle America."

In spite of conflicts of opinion certain facts are reasonably clear. There is little doubt that maize is an American plant. There have been periodic attempts to place its origin in Asia but there is no tangible evidence of any kind—archaeological, ethnographic, linguistic, ideographic, pictorial, or historical—of the existence of maize in Asia before 1492. (Mangelsdorf & Oliver, 1951) On the other hand there is overwhelming evidence of its American origin, among the most convincing of which is the recent discovery of fossil maize pollen, mentioned above, in the Valley of Mexico. This fossil pollen not only proves that there was once a wild maize native to this hemisphere but also suggests strongly that cultivated maize may have had one center of origin in Mexico.

There is archaeological evidence to support this suggestion. As noted, the most primitive prehistoric maize so far found in Mesoamerica are the tiny cobs from ~~Aeyerado~~ Ajuereado Cave Cove which may be wild maize. This maize has definite affinities with a cultivated race, Chapalote, still found in Mexico. Archaeological specimens of this same race have been found in the lowest levels of Swallow Cave in Chihuahua (Mangelsdorf and Lister, 1956) and it is possible that the earliest corn of Bat Cave, is also of this race (cf. Mangelsdorf and Lister, 1956).

The earliest maize of La Perra Cave in Tamaulipas, dated at 4450 years, is related to another living Mexican race, Nal-Tel, (Mangelsdorf, MacNeish, and Galinat, 1956) and shows that even at this early date there were already distinct races of maize in Mexico. This indicates either that domestication had already proceeded to the point of producing

considerable diversification in cultivated maize or that distinct geographical races of wild maize occurred in various parts of Mexico and were domesticated wherever they were found.

It is now possible to identify with respect to race these archaeological specimens of maize in Mexico because of the comprehensive studies of living maize of Mexico made by Wellhausen *et al*. (1952). These authors recognized in Mexico four primitive races: *Palomero-Toluqueño*, *Arrocillo Amarillo*, *Chapalote*, and *Nal-Tel*, which they designated as "Ancient Indigenous" because there is no evidence of their having been introduced from elsewhere. Four additional races: *Cacahuacintle*, *Harinoso de Ocho*, *Olotón*, and *Maíz Dulce*, were designated as "Pre-Columbian Exotic Races" because they clearly have affinities with the maize of South America and because several of them became the parents of hybrid races which are known, from replicas on funerary urns, impressions in lava, and actual prehistoric specimens, (including those of *Breve de Padilla* and Dzit-Bacó al mentioned earlier), to have originated in pre-Columbian times. The South American affinities of these exotic races are well established by the subsequent studies of Roberts *et al*. (1957) of the races of maize of Colombia and of Wellhausen *et al*. (1957) on Guatemalan maize. The latter shows that several other races in addition to the four Mexican races mentioned above were introduced into Mesoamerica from South America. It may be worth noting in passing that all of these introductions of South American maize occurred in western parts of Guatemala. This is also clearly true of three of the Mexican exotic races.

These introduced races from South America were more productive than the indigenous races. Why, if maize originated in Mesoamerica it should

have evolved more rapidly in South America than in its native region, is a question not yet completely answered, although there is evidence that there has been hybridization in South America, not only between distinct races, but also with corn's hardy wild relative *Tripsalvia* cum (Mangelsdorf & Reeves, 1959, pp. 400-404. 1959 a, pp. 421-422). The important fact for the present discussion is that the introduction of these productive South American races and their subsequent hybridization with indigenous races and with teosinte to produce still better races, the "Prehistoric Mestizos" of Wellhausen *et al.*, undoubtedly had a revolutionary effect upon the agriculture of Mesoamerica. Indeed it is quite possible that the flowering of civilization in Mesoamerica is related to the arrival in that region of the agriculturally superior South American races.

The old idea, that agriculture in this hemisphere came into full development when maize was domesticated, is no longer tenable. The wild maize with which domestication began was certainly not a particularly promising food plant - both beans and squashes were probably more productive in the early stages of agriculture. That maize eventually became the basic food plant of the pre-Columbian cultures and civilizations of the New World is due to its remarkable ability to evolve rapidly in a man-made environment.

4. Cotton

The New World cultivated cotton, *Gossypium hirsutum*, L. of Mexico and *Gossypium barbadense*, L. of Peru are 26-chromosome allopolyploid hybrids between two 13-chromosome cottons, one of which must have resembled the wild cotton, *G. Raimondii* of Peru, and the other, one of the Old World

cottons, *G*. *arboreum* or *G*. *herbaceum*. There is general agreement among students of cotton on this basic fact. Opinions differ, however, on the question of when this hybridization occurred. Hutchinson, Silow, and Stephens (1947) postulated that the hybridization took place in relatively recent times after man, crossing the Pacific by raft or canoe, introduced the Old World cultivated cotton, *G*. *arboreum*, into Peru where it came within the range of the native wild cotton, *G*. *Raimondii*, with which it hybridized. The cultivated Peruvian species, *G*. *barbadense*, and the Mexican species, *G*. *hirsutum*, as well as the wild 26-chromosome Hawaiian species, *G*. *tomentosum*, are assumed to have evolved from this original hybrid.

There are numerous objections to this theory, one of the most formidable being that it does not allow time enough for the differentiation of the New World 26-chromosome cotton into three distinct species and a number of well-differentiated varieties, *punctatum* and *marie-galante* of *G*. *hirsutum* and *brasiliense* of *G*. *barbadense*. Especially difficult to reconcile with the theory is the wild *G*. *tomentosum*, a typical Hawaiian endemic, a lintless cotton far removed in many other of its characteristics from its mainland relatives. Other students of cotton, although recognizing the hybrid nature of the 26-chromosome species, have assumed that this hybridization occurred before the New World and Old World species had become completely separated in their ranges at a time in the remote geological past when the floras of parts of America and parts of the Old World, South America and Africa, for example, were more or less continuous. This assumption has received support from recent cytological studies which indicate that *G*. *barbadense*, the cultivated cotton of Peru, is probably more closely related to *G*. *herbaceum*,

the cultivated cotton of Africa, the Near East, and western India than it is to *G. arboreum*, the cultivated cotton of western India, China, and other parts of Asia.

Whatever their origin, the two American cultivated cottons are quite distinct and probably represent separate domestications. *G. hirsutum* appears to have its center of diversity in southern Mexico and Guatemala with one of its two varieties, *punctatum*, extending into the Greater Antilles and the other, *marie-galante*, into the Antilles and northern South America. *G. barbadense* is the cotton of Peru and western South America with one of its varieties, *brasiliense*, spreading into northeastern South America and through the Antilles. Hutchinson *et al.* assume that this spread from the original centers is recent but we are convinced that it is ancient, much, if not most, of it having occurred before man arrived on the scene.

The earliest archaeological remains of *G. hirsutum* in Mexico and of *G. barbadense* in Peru occur at about the same time, 1700 years B.C. for the former and 2000 years B.C. for the latter. The similarity in dates is probably a coincidence. Both remains probably represent wild cotton and the domestication of the two species was probably quite independent.

5. Tobacco

Tobacco, like cotton, is represented by two cultivated species, *Nicotiana Tabacum*, L. and *Nicotiana rustica*, L. The former is South American in origin but it is possible that its use spread to parts of Central America and southern Mexico in pre-Columbian times. In most of Mexico, however, as well as throughout the southwestern and eastern the cultivated cotton of Africa, the Near East, and western India then it is to G. arboreum, the cultivated cotton of western India, China, and other parts of Asia.

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United States and eastern Canada the cultivated tobacco was *N. rustica* which has a nicotine content three to four times as high as that of *N. Tabacum* a fact which may account for the circumstance that many tribes used the toxic weed only ceremonially and not for pleasure.

The tobaccos like the cottons are allopolyploid hybrids. *N. Tabacum* has never been found in the wild but its putative parents, *N. sylvestris* and a species of the section, *Tomentosae*, *N. otophera*, are in contact today in northwestern Argentina and adjacent Bolivia which suggests that this may be the original area of its natural distribution (Goodspeed, 1954, p. 373).

The other cultivated species, *N. rustica*, apparently has for its progenitors, *N. paniculata*, which has a range comprising nearly the entire length of western Peru and *N. undulata*, which ranges from northern Peru to northwestern Argentina. The hybrid species, *N. rustica*, is highly polymorphic with a long history as a cultigen. It is unknown in the wild with the exception of the variety, *pavoni*, which ranges from the southwestern Ecudorian inter-Andine highlands through the western flanks of the Andes of southern Peru and adjacent northern Bolovia (Coodspeed, 1954, p. 355). This wild variety is quite different from the cultivated forms which probably had their origins in Mesoamerica.

It is probable that ~~a~~ the domestication of *N. rustica* in Mesoamerica was independent of that of *N. Tabacum* in South America.

6. Bottle Gourd

Belonging to the same family as the edible squashes is the inedible bottle gourd, *Lagenaria siceraria* (Mol.) Standl. Remains of this gourd

represented by fragments of rinds were found in all levels of the Ocampo Caves beginning at 7000 - 5000 B.C.; however, seeds, which furnish a more positive identification, did not appear until the M mesa de Guaje Phase at 1400-500 B.C.

If we accept the identification of the early specimens based on rinds alone, we are presented with a puzzling problem. Lagenaria has never been found in the wild in America and it is known to be an Old World cultigen probably of considerable antiquity. How did it reach Tamaulipas in Mexico at so early a date? Towle (1952, p. 182) has suggested that the fruits of this species may have been carried to America from Africa by ocean currents and the experiments of Whitaker and Carter (1954) on floating fruits in sea water have shown this to be a possibility. It might be supposed, however, that such ocean currents would have introduced the plant into the eastern part of South America and it may be as Sauer (1950, p. 506) has stated that "The Theory of its accidental dissemination involves, in addition to the undamaged transit of an ocean, a waiting agriculturalist who carried it in from the sea shore to a suitable spot of cultivation."

If this assumption has validity then agriculture in America must have had its beginnings not in Mexico or Peru but in eastern South America, not with a native seed plant but with a root-culture tradition, probably based on manioc, serving as the ready recipient for the ocean-borne Lagenaria, an exotic species whose fruits were useful primarily as utensils. The culture of Lagenaria, minus the manioc, must then have spread at very early dates to both Mexico and Peru. Such an hypothesis demands an improbable number of fortuitous circumstances.

Perhaps the time has come to take a broad new look at the genus, Lagenaria. Perhaps it, like the genus Gossypium and many other genera both living and fossil, was common to both America and Africa and its great diversity, even in the earliest times, is the product, not of centuries ~~countries~~ of domestication but, of millions of years of evolution in nature. The bottle gourd, perhaps more than any other species involved in tracing the origins of American agriculture, needs the attention of taxonomists, geneticists, and cytologists.

II. MESOAMERICAN PLANT CULTIVATION IN THE NEW WORLD SETTING

In Precolumbian times Mesoamerica enjoyed a cultural dominance on the New World scene. Along with Peru it was one of the geographic centers from which the influences of civilization radiated outwards to areas of lesser cultural intensity. To what extent was this role of dominance a function of priority in the development of agriculture? Although centers of cultural elaboration are not necessarily centers of origin as well, archaeological evidence strongly suggests that Mesoamerica was an important primary hearth, as well as a zone of climax, for plant cultivation. It is highly likely that maize, beans, and squashes -- those three staples of native American diet -- were all first cultivated within or very near to Mesoamerica.

The earliest archaeological occurrence of domesticated squash or pumpkin (*Cucurbita pepo*) comes from northern Mesoamerica in Tamaulipas. These Infiernillo and Ocampo phase appearances of pumpkin seeds antedate the New Mexican Bat Cave findings of pumpkin by more than a thousand years (Smith, 1950) and the Adena pumpkin remains of the Ohio Valley by several thousand years (Goslin in Webb and Baby, 1957). South of Tamaulipas, in Mesoamerica, the pumpkin is not abundantly documented from archaeological levels.~~(2)~~ 9 Still farther south, in Peru, this pumpkin does not occur. These data, few though they are, virtually establish a point of domestication in or near Mesoamerica. Another squash, the *Cucurbita moschata*, is placed at about 2,000 B.C. in both Tamaulipas and in distant Peru (Whitaker and Bird, 1949). These findings, together with the greatest modern diversity for *moschata* being established in southern Mesoamerica, hint at a southern

Mesoamerican primary domestication well before 2,000 B.C. with a subsequent spread northward and southward at least to northwestern South America. Recent finds in southern Puebla tend to confirm this hypothesis *Cucurbita mixta*, the walnut squash, seems to be the latest of the three as a domesticate. It has been found in both Tamaulipas and in Ventana Cave, Arizona, at about A.D. 300 (Whitaker, Cutler, and MacNeish, 1957). Almost certainly it is a north Mexican or Mesoamerican domesticate.

The cultivated common bean, *Phaesolus vulgaris*, is known first from the Ocampo phase in Tamaulipas, at 5,000 to 3,000 B.C. In the Southwestern United States *Phaesolus vulgaris* is found in Bat Cave at about 1,000 B.C. (Smith, 1950), and in the eastern United States it is no earlier than the Hopewellian horizon of the time of Christ or later (Wedel, 1943, p. 26. In Peru, *Phaesolus vulgaris* does not appear until approximately 400 B.C. (Bennett and Bird, 1949, p. 142). These dates and distributions favor Mesoamerica as the first seat of domestication of *Phaesolus vulgaris* although it should be remembered that the Peruvian form of this bean may have had a separate and independent domestication. Within Mesoamerica it is not likely that Tamaulipas was the original point of cultivation. The presence, today, of a wild variety of bean in southern Mexico and Guatemala but recent finds in Puebla do not confirm this hypothesis argues for a southern Mesoamerican homeland (Dressler, 1953). The lima bean, *Phaesolus lunatus*, is no earlier than the early Palmillas phase (A.D. 0 - 500) in the Tamaulipas sequence, but in Peru it is one of the oldest domesticates, dating back to 2,000 B.C. Again, as mentioned earlier, this does not signify a south-to-north diffusion, as the Mesoamerican and Peruvian varieties of *Phaesolus lunatus* are clearly different and it is likely that they represent separate and independent domestications of wild beans.(~~1~~)7

For Zea mays or American Indian corn the archaeological evidence is predominantly on the side of a Mesoamerican primary domestication. Most likely, this was a southern Mexican domestication beginning as early as 4000 ~~2000~~ B.C. or before. It would appear that the earliest diffusions of this primitive but cultivated maize were northward from this center, to Tamaulipas, Sonora (Mangelsdorf and Lister, 1956), and the southwestern United States (Mangelsdorf and Smith, 1949; Irwin and Irwin, 1959). Even at this very early date (ca. 3,000 to 2,000 B.C.) there were two races of Zea mays. The Sonoran and Bat Cave New Mexican specimens belong to a pod-pop type which has affinities with the modern race) Chapal~~ere~~ote, while that from the Tamaulipas caves is an early Nal-tel type (Ibid.; Mangelsdorf, MacNeish, and Calinat, 1956). Apparently, the spread of primitive Mesoamerican maize to Andean South America was somewhat later than this. On the north Peruvian coast it is dated between 1400 and 1200 B.C. (Collier, Ms., 1959). Whether or not maize had also been domesticated independently in Peru before this, is an interesting question. If, as Mangelsdorf and Reeves (1959, p. 422) have suggested, the great diversification of maize in Peru is the result of hybridization between the early and primitive Mesoamerican popcorn with the Peruvian popcorn, Confite Morocho, then it might be argued that Confite Morocho resulted from a separate Peruvian domestication of local wild maize. As yet, however, this problem is not resolved.

Several other important plants have an early history in Mesoamerica although they did not necessarily originate there, nor is it certain they are all early domesticates. The chili pepper (Capsicum annuum and C. [illegible]) the ubiquitous Mesoamerican condiment, is one of these. It occurs in Tamaulipas in the Infiernillo phase (7,000 - 5,000 B.C.), and in Peru it

is known from the earliest Huaca Prieta levels (ca. 2,000 B.C.) (Bird, 1948). As wild chili ranges, intermittently, over an area from the southwestern United States to Brazil, it is possible that domestication took place, independently, in several localities (Dressler, 1953). Although it is difficult to tell wild from cultivated varieties, the absence or scarcity of the wild species of Capsicum in highland Tamaulipas today suggests that the archaeological specimens of the plant found in that region are domesticates (MacNeish, Ms., 1959).

New World cotton occurs as two species. Gossypium hirsutum is as early as 1700 B.C. in Tamaulipas and a closely related variety is in the southwestern United States by the first millennium B.C. (Martin, et al, 1952). The other species, Gossypium barbadense, is found in Peruvian preceramic contexts at 2,000 B.C. (Bennett and Bird, 1949). Apparently these were separate and independent domestications. The story of tobacco is probably similar. Nicotiana tabacum seems to have been first cultivated in the South American tropical lowlands, spreading from there to the West Indies and possibly to Central America and Southern Mexico. Nicotiana rustica, the species known earliest from Mesoamerica and eastern North America, probably originated as a domesticate in Mesoamerica and gradually spread northward from there to the southwestern and eastern United States and eastern Canada. This was the tobacco known in the Mississippi Valley as early as the first millennium B.C. (Webb and Baby, 1957). Lagenaria, the bottle gourd, which dates from the Infiernillo phase in Tamaulipas, & early in Puebla, is also early in Peru (Bennett and Bird, 1949; Towle, 1952), in Bat Cave, New Mexico (Smith, 1950), and in the eastern United States (Funkhouser and Webb, 1929). The ambiguities

and problems surrounding the history of this particular plant have been discussed in detail above. In any case this history is not the most critical for the rise of Mesoamerican agriculture as are some others.

A number of root crops, belonging to a South American tropical lowland tradition of "vegetative planting," were introduced into Mesoamerica as domesticates in relatively late prehistoric times (Sauer, 1959). Among these the peanut (*Arachis hypogaea*), the sweet potato (*Ipomoea Batatas*), and manioc (*Manihot esculenta*) were the most important. Manioc occurs at Huaca Prieta in Peru on a time level of 750 to 400 B.C. (Collier, Ms. 1959); in Tamaulipas it is first found at 300 B.C. - 0 when it probably was not a domesticate but the wild Mexican *M. dulcis* (MacNeish, 1959). It is almost certain that it was cultivated in northeastern South America much earlier than any of these dates (Willey, 1960a).

To conclude, within the larger New World setting Mesoamerica was a primary center for plant domestication. Native agriculture developed slowly here at first over a span of several millennia which we have designated as an "era of incipient cultivation". Then, as plants were improved through cultivation and selection they were also interchanged throughout the area so that by the beginning of the first millennium B.C., if not considerably before, Mesoamerica became essentially dependent upon an agricultural way of life. From the very earliest beginnings of incipient cultivation there appears to have been diffusion of plants and ideas concerned with their domestication out of the Mesoamerican area. Then, with the establishment of full village agricultural subsistence, Mesoamerica became even more of a heartland for the propagation of agriculture to

lands beyond its borders. Conversely, it also assimilated cultivated plants originating in other areas; and it was the recipient of new improved secondary ~~recording~~ types of old Mesoamerican cultigens which elsewhere had hybridized with other races and wild relatives, and thus had evolved more rapidly than the primary types in their original center. of ~~origin~~. Such, very briefly, is the history behind the amazing agricultural richness and diversity of Mesoamerica which Cortez viewed in the early 16th century.

Botanical Museum, Harvard University
National Museum of Canada, Ottawa
Peabody Museum, Harvard University
July 1960.

Footnotes

1) Of the six pumpkin seeds (Cucurbita pepo) in Infiernillo refuse, three are quite small and probably wild; but in the opinion of Whitaker and Cutler the other three seeds, all larger, appear to be domesticates.

2) The evidence for maize in La Perra is from corn cobs.

3) Excavation has reported of the A~~eyerado~~ juereado Cave was carried out by MacNeish in early 1960. Mangelsdorf examined the maize cobs from ~~Aeyerado~~ Ajuereado in March of the same year.

4) Samples have been sent to the University of Michigan Laboratory for radiocarbon analysis.

5) See also Deevey (1944) for a record of maize pollen in soil borings, taken from vicinity of Lake Paty~~euono~~ zcuaro, Mich~~igan~~ oacan. Maize pollen in this sequence cannot be dated definitely although there is the reasonable likelihood that it may be as ancient as the early Post-pleistocene.

6) For detailed information on other cultivated species not treated further here, the reader is referred to Dressler's paper and to its extensive bibliography of 220 titles.

7. Personal communication, M.A. Towle, 1960.

8) Personal communication, A. Grobman, 1960.

9) MacNeish, this volume, refers to a Cucurbito ~~pepo~~ moschata seed in the early level of Aeyerado Cave, southern Puebla.

[illegible]
([illegible])

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[illegible]	[illegible]	Amaryllidaceae
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	"
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]

Cultivated for Their Edible Gourd-like Fruits.

Chayote	*Sechium edule* Sw.	Cucurbitaceae
[illegible]	*Cucurbita moschata* Duch.	"
[illegible]	*Cucurbita Pepo* L.	"
[illegible]	*Cucurbita maxima* Duch.	"
[illegible]	*Cucurbita ficifolia* Bouché	"

Other Edible Fruits.

[illegible]	[illegible]	Rosaceae
[illegible]	[illegible]	"
[illegible]	*Prunus* [illegible] L.	"
[illegible]	*Prunus* [illegible]	"
[illegible]	*Prunus cerasifera* Ehrh.	"
[illegible]	*Prunus* [illegible] L.	"
[illegible]	[illegible] L.	"
Avocado	*Persea americana* Mill.	Lauraceae
[illegible]	*Persea drymifolia* Cham.	"
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	"
Cashew	*Anacardium occidentale* L.	Anacardiaceae
[illegible]	*Mangifera indica* L.	"
[illegible]	*Spondias* [illegible] L.	"
[illegible]	*Vitis vinifera* L.	Vitaceae
[illegible]	[illegible] Presl.	[illegible]
Guava	*Psidium Guajava* L.	Myrtaceae
[illegible]	*Psidium Cattleianum* [illegible]	"
[illegible]	*Rhodomyrtus tomentosa* (Ait.) Hassk.	[illegible]

[illegible]	*Calocarpum viride* Pitt.	Sapotaceae
[illegible]	*Pouteria campechiana* (HBK.) Baehni	"
[illegible]	*Manilkara zapotilla* (Jacq.) Gilly	"
[illegible]	*Casimiroa sapota* Oerst.	Rutaceae
[illegible]	*Casimiroa edulis* La Llave & Lex.	"
[illegible]	*Byrsonima crassifolia* (L.) HBK.	Malpighiaceae
[illegible]	*Carica Papaya* L.	Caricaceae
Pineapple*	*Ananas comosus* (L.)Merrill.	Bromeliaceae
[illegible]	*Hylocereus undatus* (Haw.) Britt. & Rose	Cactaceae
[illegible]	*Opuntia streptacantha* Lemaire	"
[illegible]	*Opuntia megacantha* Salm-Dyck	"
[illegible]	*Opuntia Ficus-indica*(L.) Miller	"
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]

Pot Herbs and Other Vegetables

[illegible]	*Cnidoscolus chayamansa* McVaugh	Euphorbiaceae
[illegible]	*Crotalaria longirostrata* Hook. & Arn.	Leguminosae
[illegible]	*Cucurbita ficifolia* Bouché	Cucurbitaceae
[illegible]	*Cucurbita* [illegible]	"
[illegible]	*Lycopersicon esculentum* Mill.	Solanaceae
[illegible]	*Physalis ixocarpa* Brot.	"
[illegible]	*Yucca elephantipes* Regel	Liliaceae

Condiments and Other Flavoring

[illegible]	*Capsicum annuum* L.	Solanaceae
[illegible]	*Capsicum frutescens* L.	"
[illegible]	*Vanilla planifolia* Andr.	Orchidaceae

Plants Used for Living Fences

Dahlia	*Dahlia lehmannii* Hieron.	Compositae
Órgano	*Pachycereus marginatus* (DC.) Britt. & Rose*	Cactaceae
Yucca	*Yucca elephantipes* Regel	Liliaceae
Piñoncillo	*Jatropha curcas* L.	Euphorbiaceae

Ornamental Plants

Ahuehuete	*Taxodium mucronatum* Ten.	Pinaceae
Dahlia	*Dahlia coccinea* Cav.	Compositae
Dahlia	*Dahlia excelsa* Benth.	"
Dahlia	*Dahlia lehmannii* Hieron.	"
Dahlia	*Dahlia pinnata* Cav.	"
Marigold	*Tagetes erecta* L.	"
Marigold	*Tagetes patula* L.	"
Tiger Flower	*Tigridia pavonia* (L.F.) Ker.	Iridaceae
Tuberose	*Polianthes tuberosa* L.	Amaryllidaceae

*Probably not native to Mesoamerica

[Origins of Agriculture ⑧ in ~~⑩~~ #25
Meso America Manuscript
& maps]